Eliminating Noise in Vinyl Playback Systems

Jim Hagerman
30-Aug-2017

GENERAL

Reducing or eliminating background noise to acceptable levels in vinyl playback systems can often be an arduous and difficult task. Even the quietest of phonostages can buzz like a bee if not installed properly. Fortunately, such sources of noise can be found and removed via the implementation of good practices.

PHONOSTAGES

The first thing to keep in mind is that signal levels from a cartridge (turntable) are typically a thousand times smaller than that from a CD player or DAC. This is why noise problems are so widespread. A typical Moving-Magnet phonostage will have a gain of 40dB at 1kHz. In layman terms, that's a gain of 100. However, due to RIAA equalization, the gain down at 60Hz (power line frequency) is ten times greater, or 1000. An input disturbance of 0.000005V becomes audible. With Moving Coil cartridges the problem is again ten times worse.

So what can we do? Simple, identify the possible culprits and suggest possible corrections. In many systems there is more than one issue, so eliminating noise is like peeling an onion.

NOISE SOURCES

There are many sources of noise, the most common being power line disturbances. Noise can be injected either via magnetic induction or from electric fields. And not just into the phonostage; noise can be coupled into cables, tonearm, or the cartridge itself.

SYMPTOMS

The following table lists various noise issues and what generally causes them. It only covers amplified electrical noises – not for example, the audible buzzing coming from a power transformer (loose screw or DC on primary) or the high-pitched tone emanating from a wall wart.

Issue	Possible Cause
Hiss	Normal. This is what we are trying to achieve. In a good system the level of electrical hiss is lower than that of groove noise.
Tic	Record scratch, of course. Phonostages employing feedback tend to accentuate this, as the excessive slew rate will force an open loop condition, from which the amplifier must then recover.
Crackle	Bad electrical connection. This can be caused by a loose-fitting connector, cable, or socket (especially tube). Can also be a broken solder joint.
Thump	An impulse signal caused by power-up or power-down of electronics. Mechanically either footsteps or dust cover rumble.
Hum	Magnetic induction. Typically caused by a nearby power transformer, with low frequency fields coupling to wire loops that effectively act as secondary windings. Surprisingly this is caused by too many grounds. There are many invisible loops created via ground wires, interconnect returns, and power cords. Hum can also be caused by a missing ground, but that situation tends to manifest as buzz.
Buzz	Missing ground wire. Common in audio systems that have no connection to Earth ground (usually via a 3-prong plug).
Pulsing	WiFi, cell phone. Modern digital wireless communications can couple into audio systems, as they transmit in low frequency bursts.
Whine	Nearby motor. Refrigerators or other motorized appliances can couple noise when plugged into the same power branch.
Sizzle	Insulation breakdown, often within a tube. Typically associated with higher voltages.
Voices	RF, radio interference. This is more common with solid-state phonostages, as parasitic semiconductor rectification of radio signals at the input stage performs demodulation. Metallic shielding can help, especially with input cables, where coaxial types are superior.
Hollowness	One channel inverted. Soundstage disappears.
Popcorn	Static discharge damage to semiconductors. Usually on inputs to operational amplifiers.
Howl	Acoustic feedback. Speaker too close to turntable or low quality shelf.
Muddiness	Too much resistive loading. MM cartridges need loading from 47kohm to 100kohm.
Harshness	Too much capacitive loading on cartridge. It is an old rule of thumb to add capacitance resonating with cartridge inductance, thereby causing a peak in treble frequencies in an attempt to increase bandwidth. Unfortunately, smearing and sonic degradation caused by the capacitor itself outweigh any benefit. It is a far better approach to reduce total capacitance to a minimum.

TROUBLESHOOTING

Trouble shooting can be difficult, especially if there is more than one problem to uncover. Fortunately there are a number of tricks you can employ to ferret out perpetrators.

- Try touching various metal parts that should be grounded with your finger. For example ground lugs, the tonearm, interconnect shields, chassis, etc. If the level of noise changes, you've uncovered a weak spot, usually a missing ground wire.
- Disconnect the inputs to phonostage. Does noise go away?
- Swap cables between channels. This should help detect where in the system one channel has gone bad.
- Move phonostage position and orientation. Does hum level change? You can discover which piece of equipment is the offender, usually one with a large power transformer.
- Move power cord to a different outlet.
- Turn off fluorescent lights. Does buzz go away?
- Try re-routing interconnects so that they do not run parallel with power cords, but rather cross at right angles.
- For systems with 2-prong power cords, check to make sure there is some connection to Earth (center screw on any outlet).
- Try to isolate the phonostage. Remove all WiFi routers, tablet, laptops, and cell phones that were nearby.

GOOD PRACTICES

Adding a turntable to an audio system should not be an afterthought. It may be prudent to re-assemble everything from scratch, giving primary consideration to the analog front end. If not, you may be forever chasing noise.

Start by placing the turntable and phonostage far away from power amplifiers and speakers. Give them a solid platform. Plug all source electronics into the same outlet using a power strip or line filter. Keep turntable interconnects (and ground wire) short and separated from other wiring (do not bundle). Continue building up the system in this manner, following signal path from start to finish.

Distance is your friend. Keep noise sources as far away from front-end analog electronics as possible.